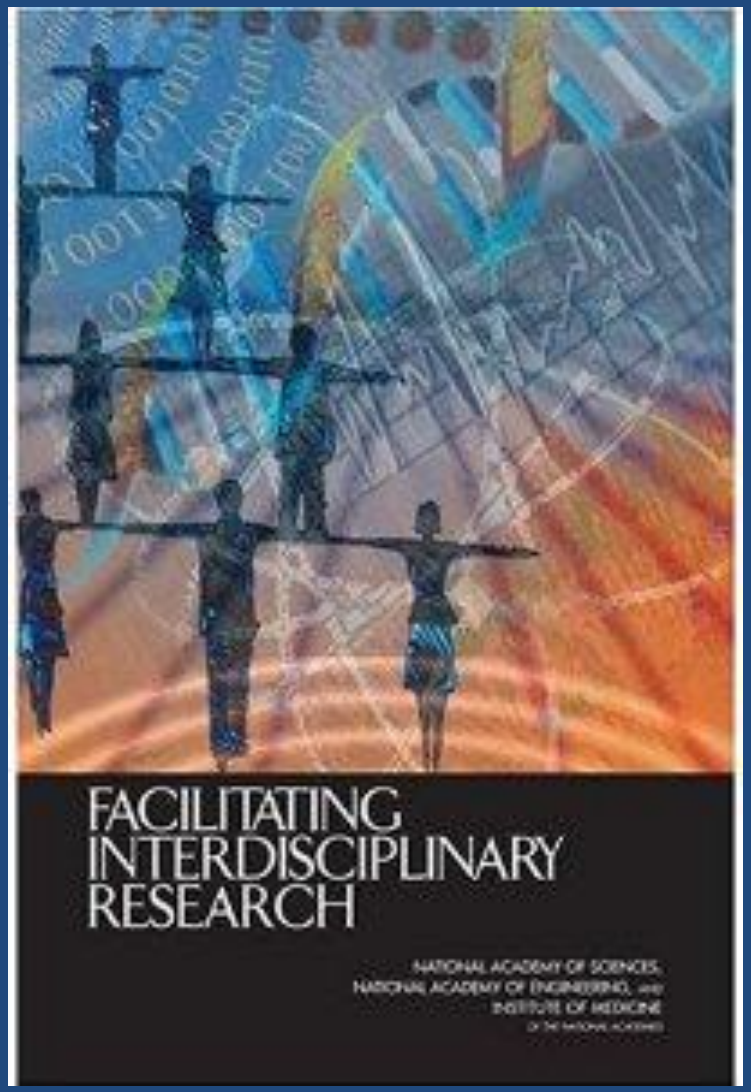
Beyond Silos and Stovepipes

A Cross-Disciplinary Perspective from NSF

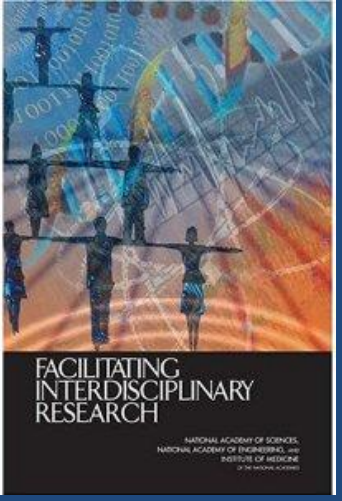
W. Lance Haworth
Director, NSF Office of Integrative Activities

Enhancing Communication in Cross-Disciplinary Research
Coeur d'Alene, Idaho
30 September 2010



"**Interdisciplinary Research** can be one of the most productive and inspiring of human pursuits – one that provides a format for conversations and connections that lead to new knowledge."

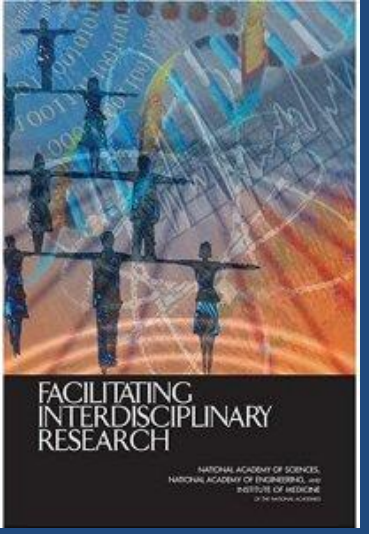
Facilitating Interdisciplinary Research - NAS 2004



A Definition

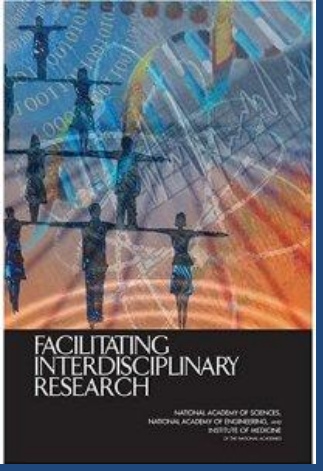
"IDR is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice."

Facilitating Interdisciplinary Research - NAS 2004



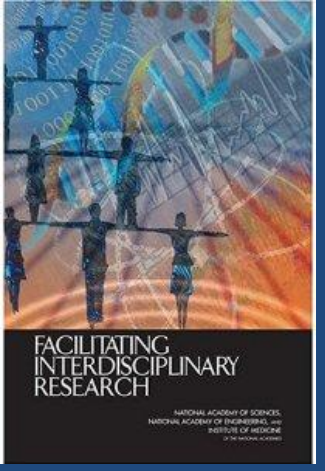
"Four powerful drivers towards interdisciplinary thinking"

- the inherent complexity of nature and society
- the desire to explore problems that are not confined to one discipline
- the need to solve societal problems
- the power of new technologies



Challenges to Overcome

"Social-science research has not yet fully elucidated the complex social and intellectual processes that make for successful IDR"



Challenges to Overcome

"The characteristics of IDR pose special challenges for funding organizations that wish to support it"

IDR is typically collaborative and involves people of disparate backgrounds. **It may take extra time for building consensus and for learning new methods, languages, and cultures**

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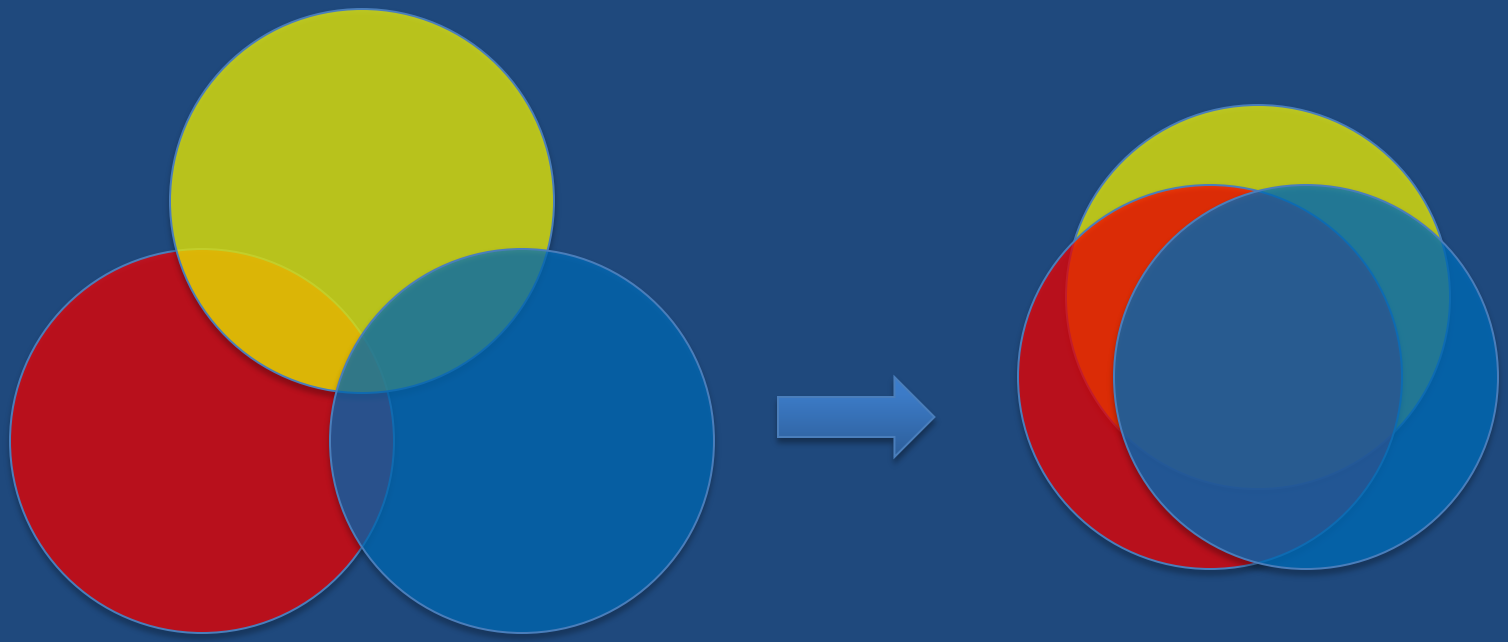


The National Science Foundation

An independent federal agency that supports fundamental research and education across all fields of science and engineering, with an annual budget of almost $7 billion

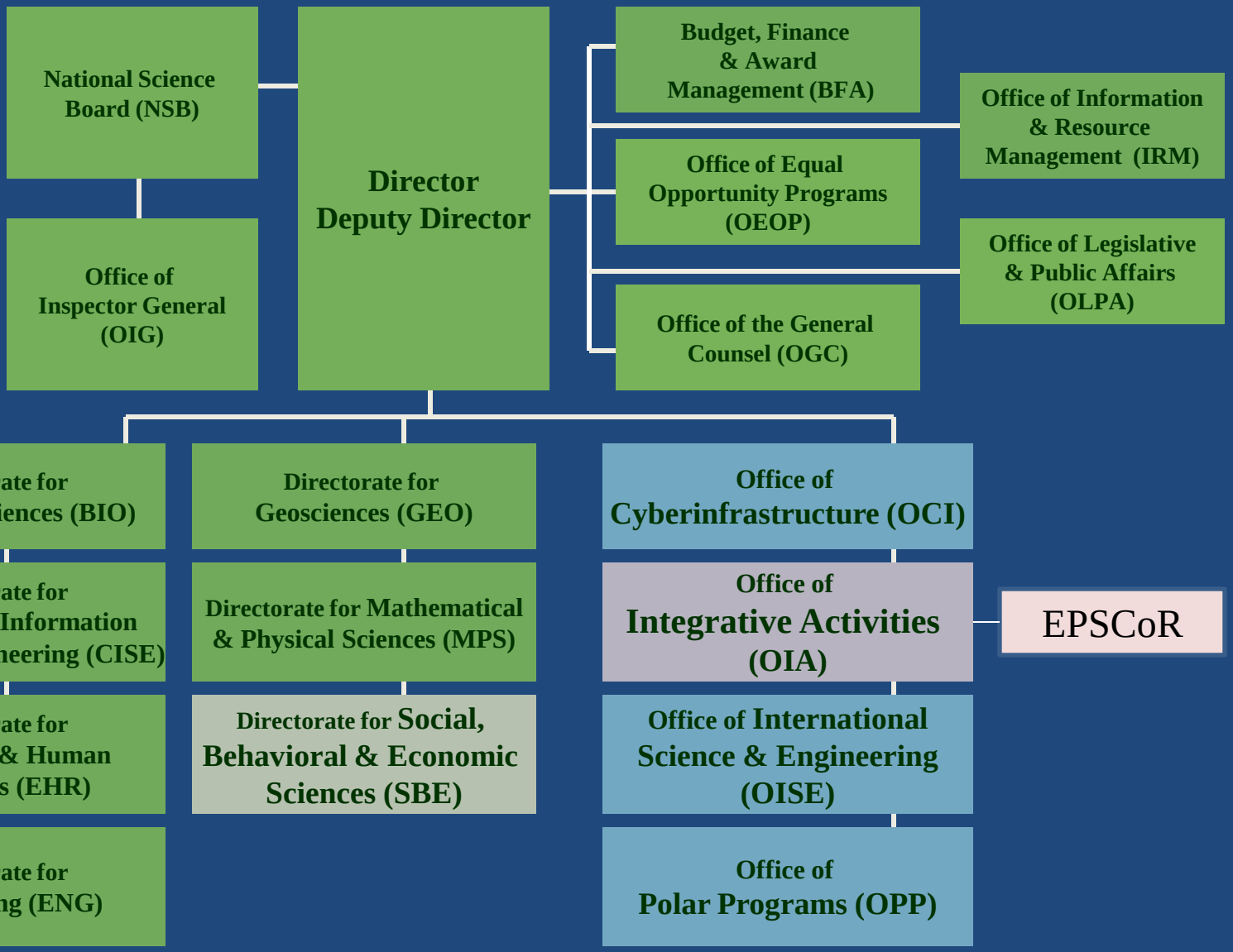
NSF funds reach all 50 states through grants to over 1,700 universities and institutions

Each year, NSF receives over 40,000 competitive requests for funding, and makes over 11,000 new funding awards

The NSF Vision

Advancing discovery, innovation and education beyond the frontiers of current knowledge, and empowering future generations in science and engineering

NSF Stovepipes????



From the NSF Strategic Plan

Discovery increasingly requires the expertise of individuals with different perspectives – from different disciplines and often from different nations -- working together to accommodate the extraordinary complexity of today's science and engineering challenges

The convergence of disciplines and the cross-fertilization that characterizes contemporary science and engineering have made collaboration a centerpiece of the science and engineering enterprise

NSF invests in the best ideas from the most capable people, determined by competitive merit review

Merit Review Criteria

- *Intellectual merit* **How good is this stuff?**
  - *Is it likely to produce new knowledge?*
  - *Does it suggest and explore creative, original, or potentially transformative concepts?*

- *Broader Impacts* **So what? Who cares?**
  - *e.g. -- on education, diversity, benefit to society, future workforce, infrastructure, dissemination, impact on other areas of science and engineering…*

Myths about NSF

- Only funds scholars at elite graduate institutions
- Only funds “famous” academics
- Once declined, you will always be declined
- Won’t fund risky science
- Advisory committees make funding decisions
- You have to get “straight excellents”
- You have to ‘fit into the box’

National Science Foundation

National Science Board

Director
Deputy Director

Office of IG

BIO

CISE

ENG

GEO

MPS

SBE

EHR

OD Offices with Program Components

Office of Polar Programs
Karl A. Erb, Director

Office of Integrative Activities
W. Lance Haworth, Director

EPSCoR Office
Henry N. Blount, Director

Office of Cyberinfrastructure
Alan Blatecky, Acting Director

Office of International Science & Engineering
Larry H. Weber, Acting Director

OD Offices

BFA

OGC

OIRM

OLPA

OEOP

OIA Programs and Activities

http://nsf.gov/od/oia/

- Major Research Instrumentation
- Academic Research Infrastructure
- Science and Technology Centers
- Support for (e.g.)
  - Committee on Equal Opportunity in Science & Engineering
  - Waterman Award & National Medal of Science
  - Summer Internships & AAAS Fellowships
  - Cyber-enabled Discovery and Innovation (CDI)
  - Interdisciplinary Research Portal
- EPSCoR

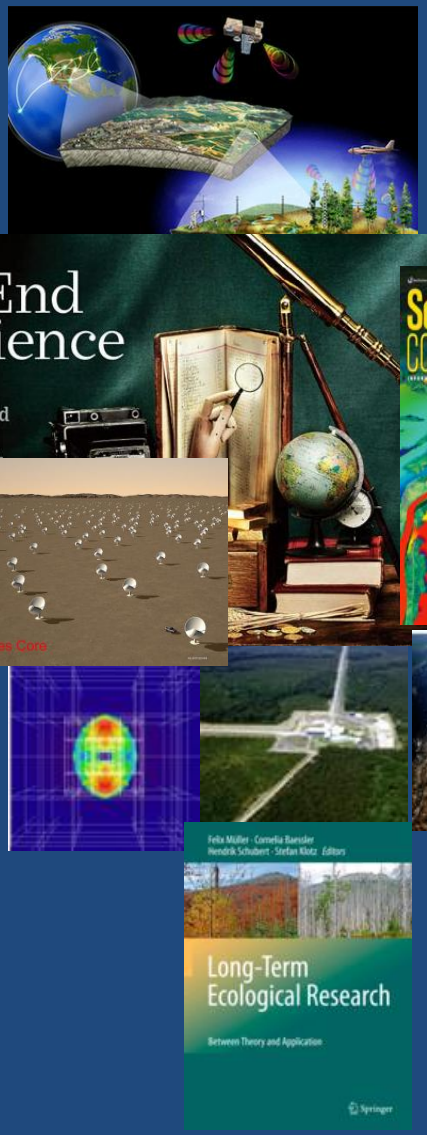
Developing STEM Talent

- AAAS Fellows
  - Provide newly minted PhDs, post-docs and mid-career scientists and engineers an opportunity to learn about science policy
- NSF Summer Scholars
  - Develop undergraduate and graduate student potential - exposure to relevant science and engineering policy, research and education issues and programs
  - Encourage students to earn graduate degrees and pursue careers in STEM

Contact: Sherrie Green
sbgreen@nsf.gov

Fundamental Change in Science

- Modern Science
  - Data- and compute-intensive
  - Integrative
- Multiscale Collaborations ***
  - Additional complexity
  - Individuals, groups, teams, communities
- Transitioning
  - Research approach to address these issues
- One way is through use of CI



Simulation-Based Engineering and Science for Discovery and Innovation

"Because of current limitations in our understanding of underlying models, the availability of critical infrastructure, and our limited ability to characterize uncertainty in simulation results, ***much of the potential for SBE&S remains just beyond reach***."

FAST TRACK ACTION COMMITTEE ON COMPUTATIONAL MODELING AND SIMULATION

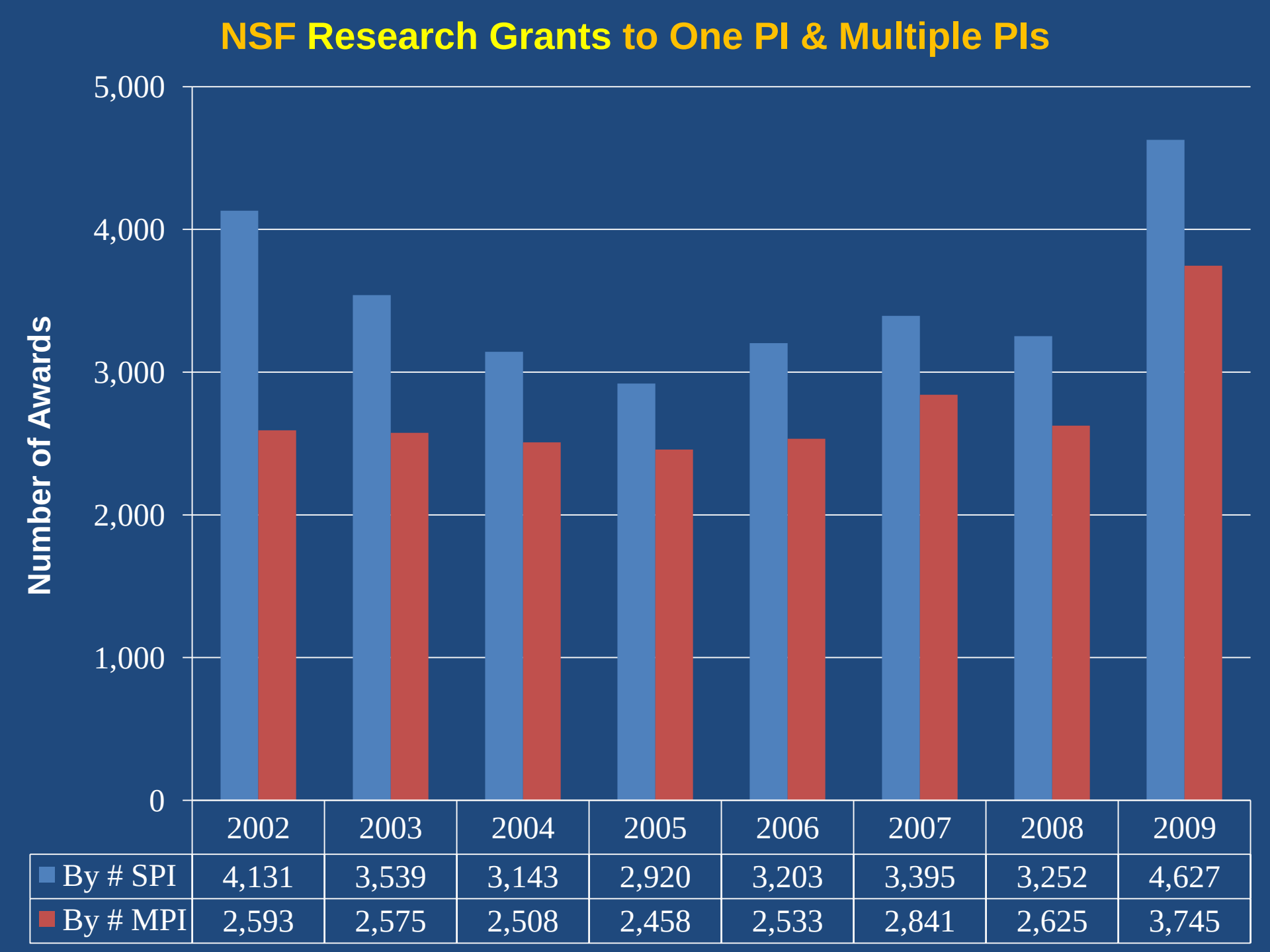
COMMITTEE ON TECHNOLOGY

NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

May 2010

http://www.whitehouse.gov/sites/default/files/microsites/ostp/FTAC_MS%20Report.pdf

NSF Research Grants to One PI & Multiple PIs



	2002	2003	2004	2005	2006	2007	2008	2009
By # SPI	4,131	3,539	3,143	2,920	3,203	3,395	3,252	4,627
By # MPI	2,593	2,575	2,508	2,458	2,533	2,841	2,625	3,745

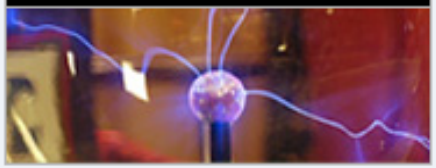
http://www.nsf.gov/
Click on ***Transformative Research***

…involves ideas, discoveries, or tools that

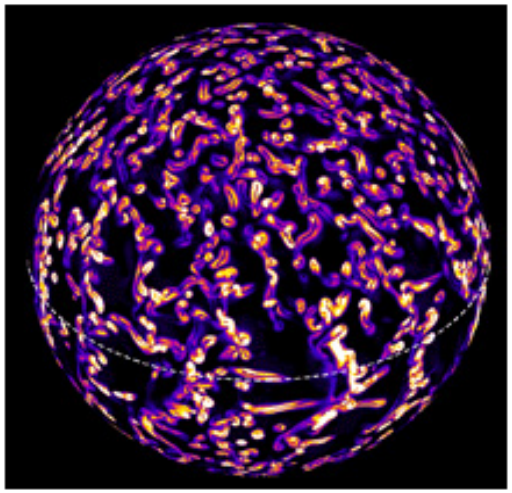
- *radically change our understanding of an important existing scientific or engineering concept or educational practice*
- *or lead to the creation of a new paradigm or field of science, engineering, or education*

Challenges current understanding or provides pathways to new frontiers

Transformative Research



Introduction to Transformative Research



As part of the larger Federal research and development effort, NSF has a comprehensive, overarching mandate to help keep all the fields and disciplines of science and engineering research healthy and strong. NSF accomplishes this through programs that support basic research proposed by individual investigators or collaborative groups of investigators. In addition to funding research through core disciplinary programs, NSF also provides support for facilities, equipment, instrumentation, centers of research, and activities such as workshops that help to advance fields of science. Most of the proposals funded by NSF also support the development of the science and engineering workforce through training of undergraduate and graduate students, and postdoctoral scientists.

This "foundational" support of research commonly results in

“Research grants: the nightmare before funding”

Nature ***437*** , 15 September 2005

“Asked to name one thing they hate about their jobs, many scientists say grant applications. Nature's reporters have asked researchers just why the process is so frustrating, and what can be done to improve matters.”

Interdisciplinary Programs

- *a few examples*

Cyber-Enabled Discovery and Innovation (CDI)

NSF's bold five-year initiative to create revolutionary science and engineering research outcomes made possible by innovations and advances in computational thinking

CDI

Cross-NSF: all directorates participating

Goals

- To support **multi-disciplinary research for advancing more than one field of science or engineering as they become increasingly computational** (referring to computational concepts, methods, models, algorithms, tools, as applied to all fields of science and engineering)

- To produce paradigm shifts in our understanding of science and engineering phenomena and socio-technical innovations

CDI

"CDI seeks *ambitious, transformative, multidisciplinary* research proposals in or across the following areas"

- **From Data to Knowledge**: enhancing human cognition and generating new knowledge from a wealth of heterogeneous digital data
- **Understanding Complexity** in Natural, Built, and Social Systems: deriving fundamental insights on systems comprising multiple interacting elements
- **Virtual Organizations**: enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries

CDI

Contact
(703) 292-8080 / cdi@nsf.gov

FY 2010 43 awards / $36M

FY 2011 – Coming Soon

Type I Awards

- Two investigators with complementary expertise; two graduate students; and their collective research needs (e.g., materials, supplies, travel) for three years

Type II Awards

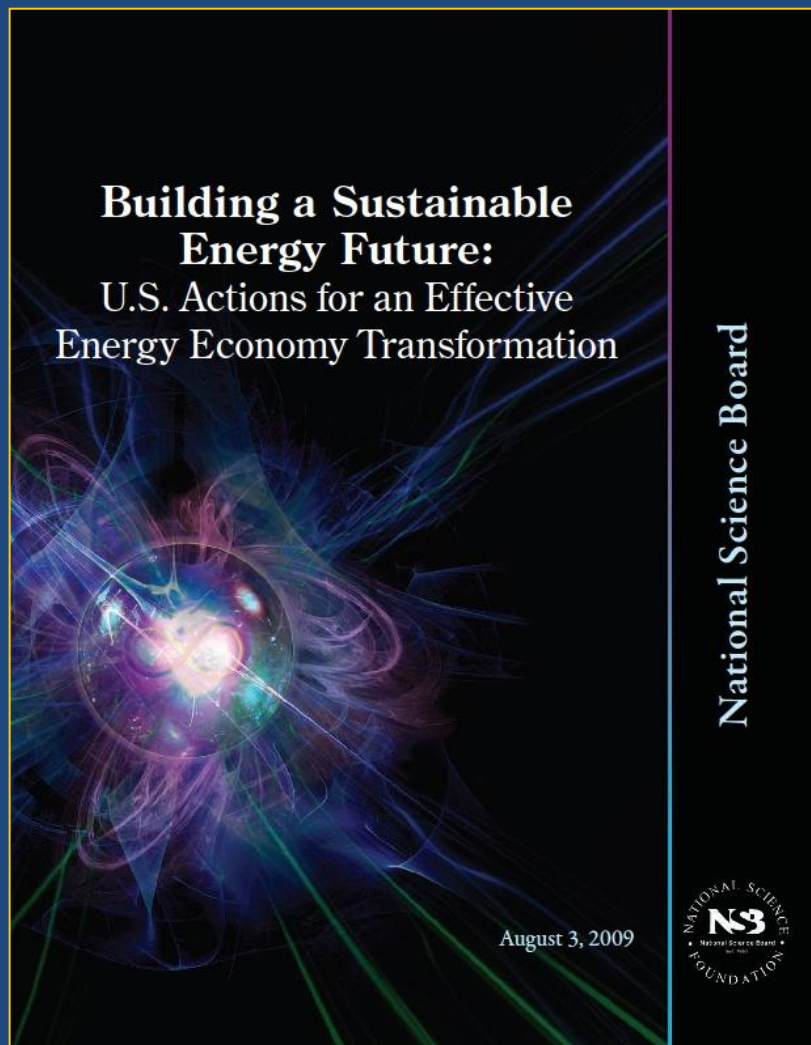
- Three investigators with complementary expertise; three graduate students; one or two senior personnel (including post-doctoral researchers and staff); and their collective research needs for four years

Science, Engineering, and Education for Sustainability (SEES)

SEES is a portfolio of programs that will integrate NSF's existing efforts in climate science and energy research with new education and cyber-based activities

FY 2011 Request: $766 million

"Dear Colleague Letter" SOON



Decadal and Regional Climate Prediction Using Earth System Models (EaSM)

This **interdisciplinary grand challenge** calls for the development of next-generation Earth System Models…
FY 2010 proposal deadline past

Dynamics of Coupled Natural and Human Systems (CNH)

Promotes **interdisciplinary analyses** of relevant human and natural system processes and complex interactions among human and natural systems at diverse scales. *Proposal deadline 9 Dec 2010*

EPSCoR Research Infrastructure Improvement Program: Track-2

Awards to **consortia of EPSCoR jurisdictions** to support innovation-enabling cyberinfrastructure of regional, thematic, or technological importance

Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (UBM)

Long-term research experiences for **interdisciplinary, balanced teams** of at least two undergraduates from depts in the biological and mathematical sciences. *Proposals due 10 February 2011*

Integrative Graduate Education and Research Traineeship Program (IGERT)

Catalyze a cultural change in graduate education for students, faculty, and institutions, by establishing innovative new models for **graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries**

Facilitate diversity in student participation and preparation, and contribute to a world-class, broadly inclusive, and globally engaged science and engineering workforce

~125 award sites. Next deadline ~ March 2011 (pre-proposals)

Science of Science and Innovation Policy

Research designed to advance the scientific basis of science and innovation policy

Invites the participation of researchers from all of the social, behavioral and economic sciences as well as those working in domain-specific applications such as chemistry, biology, physics, or nanotechnology

Welcomes proposals for individual or multi-investigator research projects….

Places a high priority on interdisciplinary research as well as international collaboration

Next proposal deadline - 9 September 2011

Science and Technology Centers: Integrative Partnerships

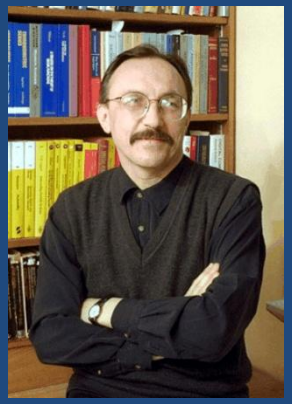
Innovative, potentially transformative, complex research and education projects that require large-scale, long-term awards

A means to undertake **important investigations at the interfaces of disciplines and/or fresh approaches within disciplines**

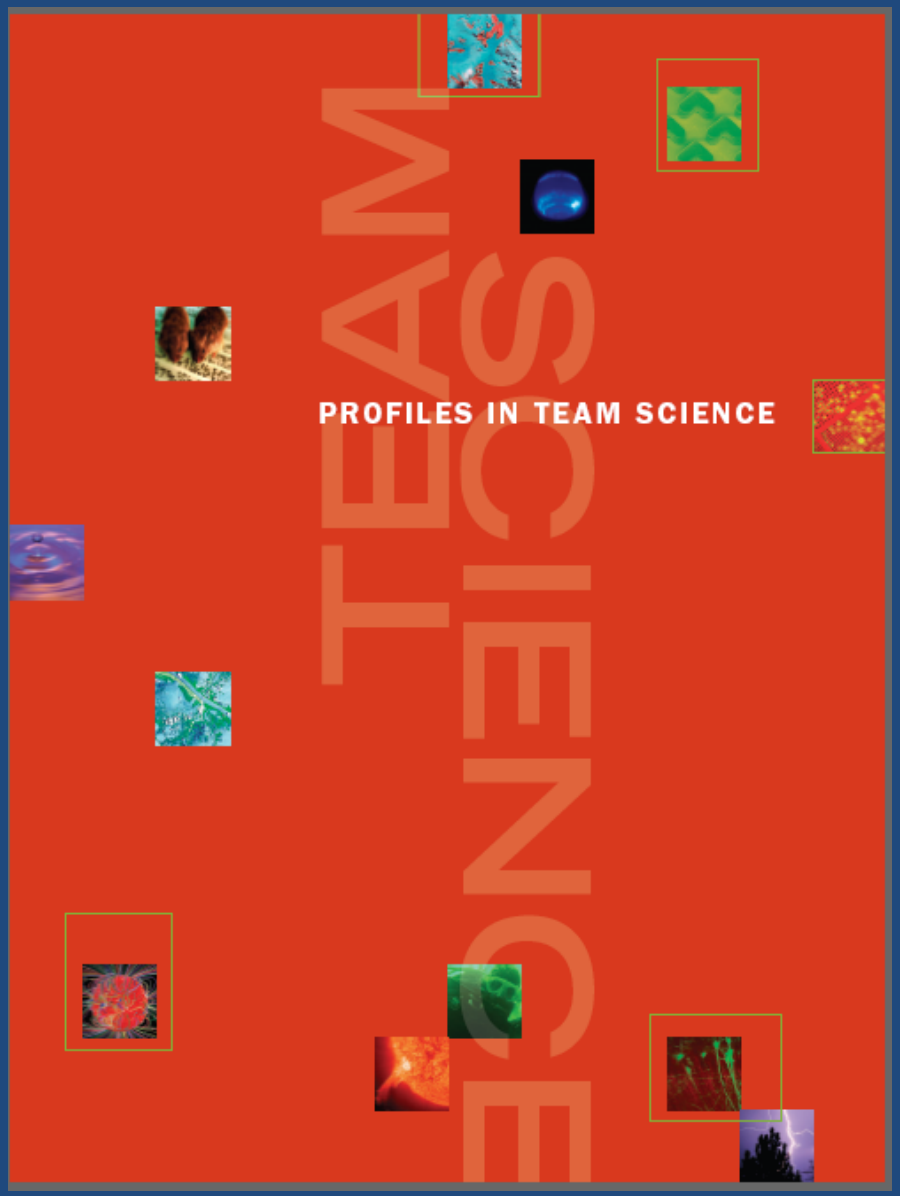
NSF expects STCs to demonstrate leadership in the involvement of groups traditionally underrepresented in science and engineering at all levels within the Center

Science and Technology Centers

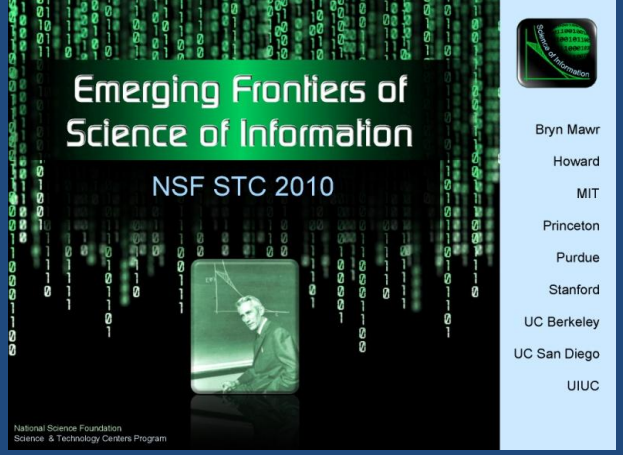
"Create a shared intellectual space, integral to the center's activities, providing a collaborative research environment that crosses disciplinary and institutional boundaries"

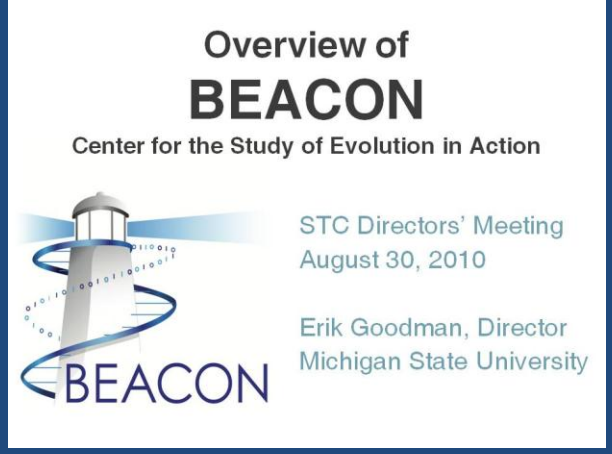


Wojciech Szpankowski, Purdue University
Director, Center for Science and Information (an NSF STC)



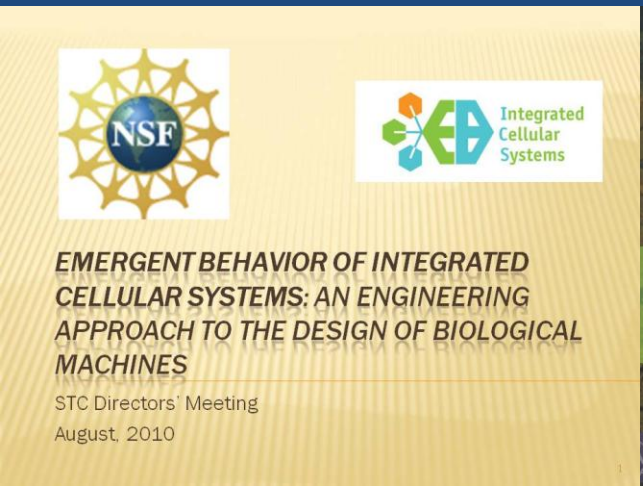
http://depts.washington.edu/teamsci/welcome.html

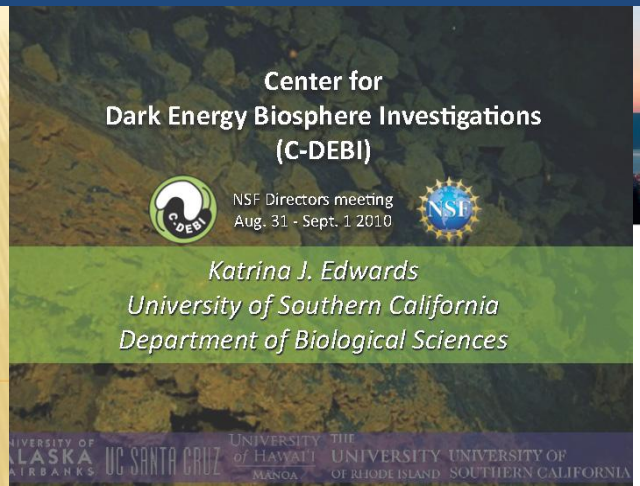


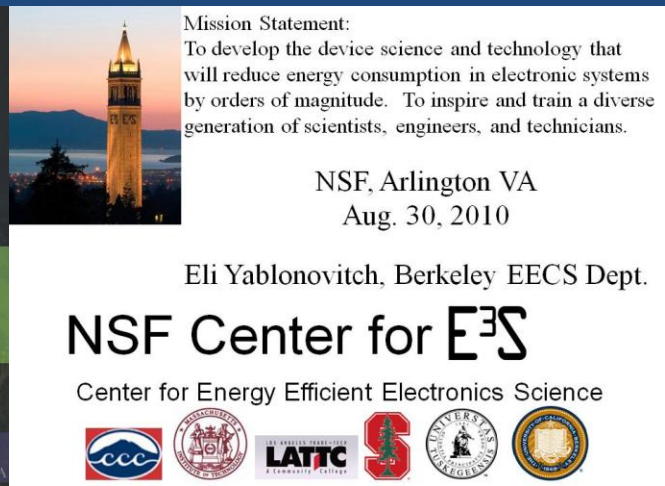


Five new STCs established in 2010

New solicitation in FY 2011







But what if our idea doesn't fit one of NSF's boxes??

Interdisciplinary Research

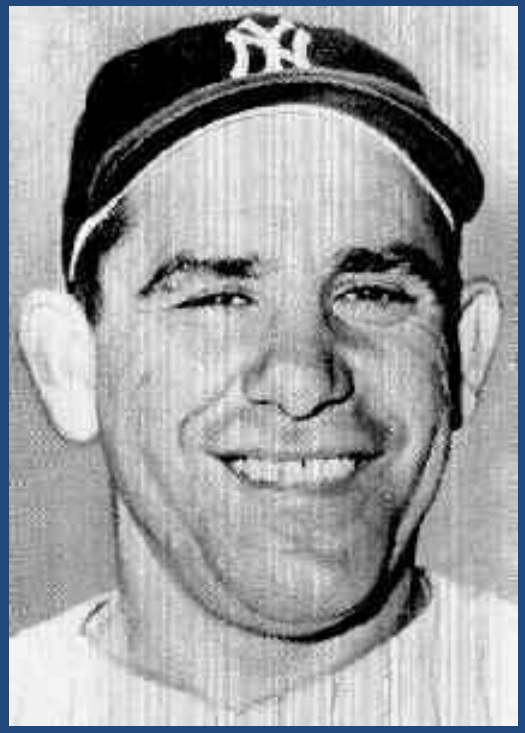
OIA mission, cooperatively across NSF

Encourage research across disciplinary boundaries

Ensure that ideas that challenge current boundaries of science are examined appropriately

Ensure that disciplinary boundaries are not barriers to the advancement of transformative ideas

*This includes **unsolicited proposals** in particular*



"You've got to be very careful if you don't know where you're going, because you might not get there."

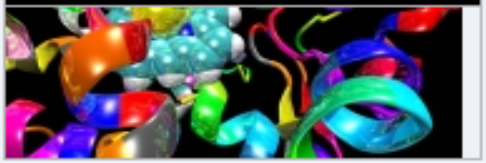
Interdisciplinary Research Portal

http://www.nsf.gov/

A guide to the mechanisms through which NSF promotes and supports interdisciplinary research. It provides information on who to contact for assistance in deciding where and how to submit an interdisciplinary proposal.

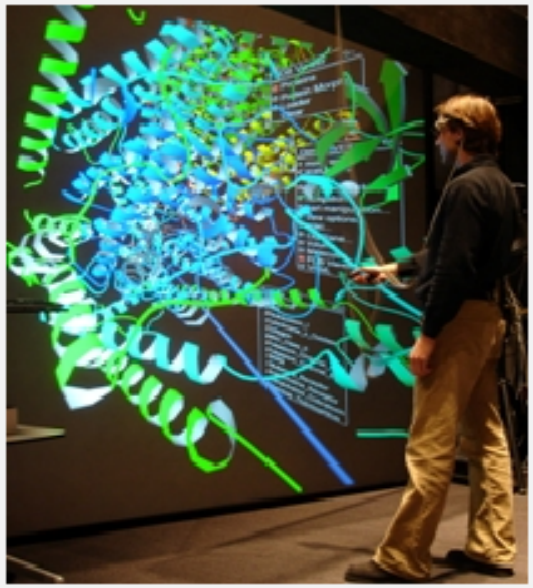
A primary purpose is to assist investigators in submitting an unsolicited interdisciplinary proposal for which there may not be a natural "home" in one of the existing NSF programs.

Interdisciplinary Research



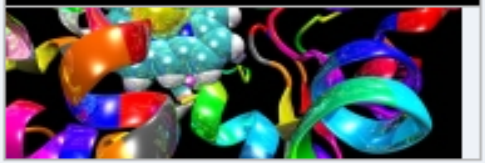
Introduction to Interdisciplinary Research

NSF has long recognized the value of interdisciplinary research in pushing fields forward and accelerating scientific discovery. Important research ideas often transcend the scope of a single discipline or program. NSF also understands that the integration of research and education through interdisciplinary training prepares a workforce that undertakes scientific challenges in innovative ways. Thus, NSF gives high priority to promoting interdisciplinary research and supports it through a number of specific solicitations. NSF also encourages researchers to submit unsolicited interdisciplinary proposals for ideas that are in novel or emerging areas extending beyond any particular



A virtual reality wall displays interactive visualizations of proteins.

Interdisciplinary Research

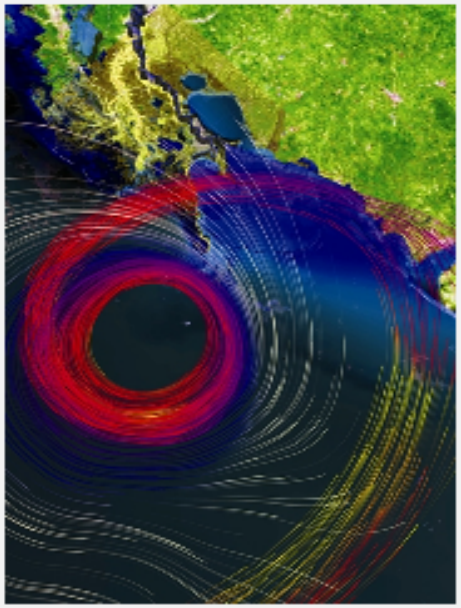


Whom Does One Contact at NSF for an Interdisciplinary Proposal?

Formulate the idea for the proposal first, before thinking about where it could be submitted and reviewed. NSF has mechanisms to assure an appropriate review of the idea.

With the idea in hand, investigators have numerous options in deciding whom to contact at NSF about submitting an interdisciplinary proposal. The NSF contact should have a programmatic interest in the proposal idea, or a responsibility for identifying someone else at NSF who has such an interest. An investigator might typically consider these options in the following order.

- Identify a Program Officer (PO) through an NSF program. In



A three-dimensional simulation of Hurricane Katrina to better

Your "Unsolicited" Interdisciplinary Research Ideas are Welcome!

who to contact

- Any NSF program officer
- A program officer listed on the IDR website
- Tom Russell in OIA – trussell@nsf.gov

or

- email an inquiry to idr@nsf.gov
  or call (703) 292-4840

http://www.nsf.gov/

Interdisciplinary Research

Innovation and Diversity

There is no more fertile ground for innovation than a diversity of experience. And that diversity of experience arises from a difference of cultures, ethnicities, and life backgrounds. A successful scientific endeavor is one that attracts a diversity of experience, draws upon the breadth and depth of that experience, and cultivates those differences, acknowledging the creativity they spark

Prof. Joseph DeSimone

Innovation and Diversity

…that diversity of
experience arises from a difference of cultures, ethnicities, disciplines, and life backgrounds

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In closing…
One view of the scientific enterprise

"The four corners of deceit: government, academia, science and media. Those institutions are now corrupt and exist by virtue of deceit. That's how they promulgate themselves; it is how they prosper."

Quoted in Nature, 9 September 2010

Alternatively…

"US citizens face economic problems that are all too real, and the country's future crucially depends on education, science and technology as it faces increasing competition from China and other emerging science powers."

Nature editorial, 9 September 2010

Thank You!

lhaworth@nsf.gov